Project HAI: The AI Revolution in Hospitality
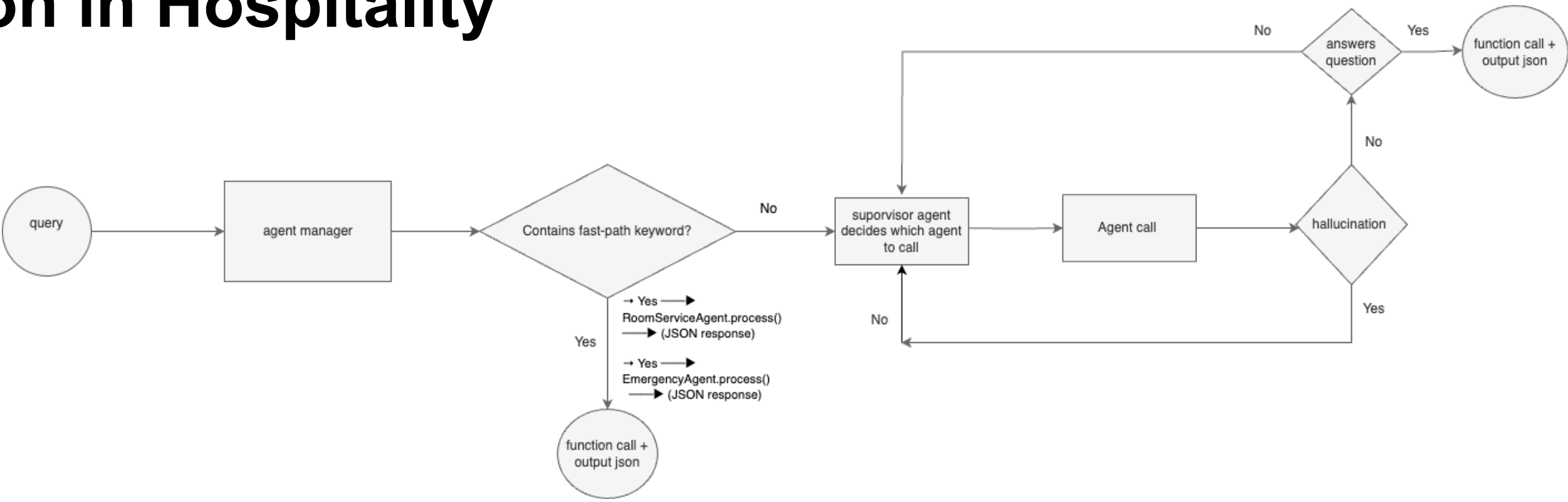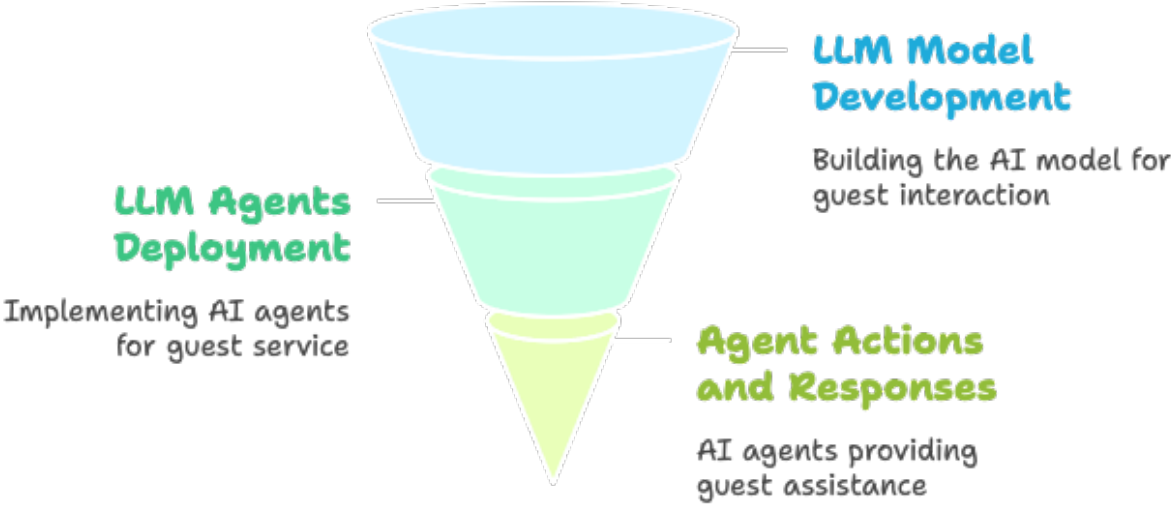
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Aims & Objectives

This project aims to create a multilingual open source fully autonomous AI-powered hotel management system designed to transform both guest experiences and business operations. Leveraging advanced LLM-driven agent architectures, the AI autonomously manages critical operational and management tasks, integrating seamlessly with CRM systems to provide intelligent customer interactions and efficient service delivery. This solution uniquely benefits both guests and business owners—guests receive personalized, proactive services, while luxury hotels, resorts, Airbnb hosts can effortlessly upsell additional services, suggest stay extensions, and streamline daily operational workflows. Ultimately, this comprehensive AI solution enhances customer satisfaction, optimizes operational efficiency, and significantly boosts profitability for hospitality businesses.

Methods

This hotel management system is built on a modular LLM-agent architecture, with everything running locally—no API calls are required. The AI is trained on synthetic engineered dataset to simulate guest interactions, ensuring high personalization. The **SupervisorAgent** directs guest messages to specialized agents like **CheckInAgent**, **RoomServiceAgent**, and **MaintenanceAgent**, ensuring seamless service. Powered by a **quantized LLaMA 3B model** fine-tuned on synthetic data, this system is optimized for edge/onsite deployment, offering fast, local processing. **LangChain** enables **retrieval-augmented generation (RAG)**, and future **LangGraph** integration will allow further fine-tuning/ performance for agents like **Wellness** and **Maintenance**.

LLM model will be evaluated for common sense, math, logic, harmful content etc With everything deployed locally, the system maximizes privacy, uptime, and minimal reliance on external servers, making it ideal for on-site use.

Ongoing Work

A comprehensive AI solution designed specifically for two distinct stakeholders:
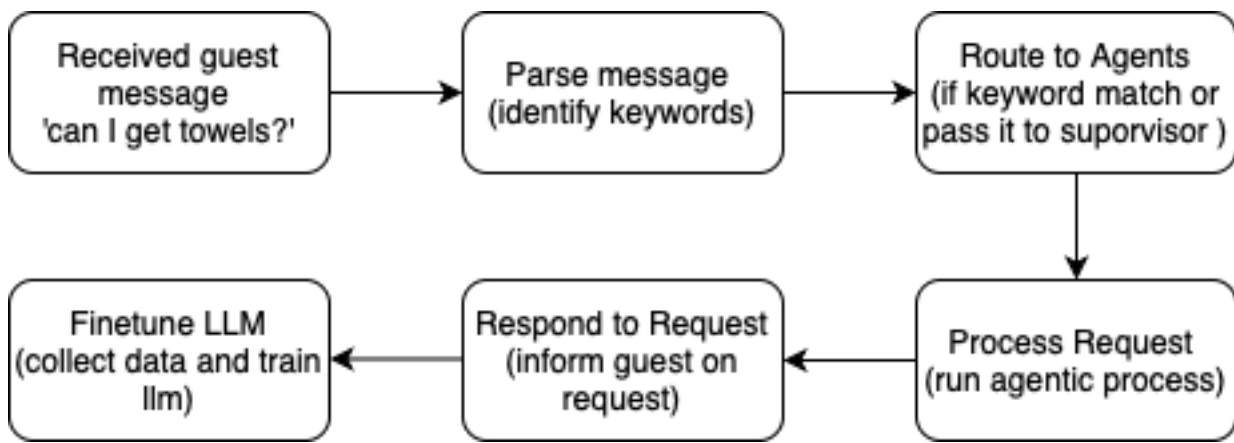
For Business Owners:
- Developed a specialized LLM based on the LLaMA 3.2 (3B) architecture, to understand tenants/guests preferences.
- Integration of LangGraph and LangChain for enhanced sequential decision-making capabilities to handle hotel management and operations tasks.
- Project capable of upselling services, sessions, products etc
- Ethical Data collection module to retrain core models and agentic models in future

For Hotel Guests:
- Rapid, cognizant response systems to swiftly address requests.
- Specialized agents including RoomServiceAgent, WellnessAgent, MaintenanceAgent, and EmergencyAgent.
- Comprehensive and proactive guest support tailored to individual needs.
- Memory component capturing guest preferences and feedback in real-time for personalized services.

Predicted Outcomes

Multilingual High quality LLM model capable of understanding hotel requests,The system delivers end-to-end automation of guest services, intelligently handling queries, routing tasks to agents, and collecting feedback for LLM fine-tuning. Outcomes include reduced staff workload, higher guest satisfaction, faster response time, and increased upselling through local integrations. Ethical data collection which provides sustained retraining of models with new data.

Acknowledgements

SCHOOL OF COMPUTING, ENGINEERING & TECHNOLOGY

MSc Data Science